Conferences and Reviews

Common Injuries of the Shoulder
Diagnosis and Treatment

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Shoulder pain is often the presenting complaint of patients seeing their primary care physicians. Overuse and traumatic injuries make up most of the causes. A physical examination with minimal diagnostic tests can lead to the correct diagnosis in most cases. Most conditions can be treated conservatively (nonsurgically). Appropriate referral to a specialist depends on the severity of the initial injury or the patient's lack of response to conservative treatment (or both). We discuss common injuries of the shoulder, emphasizing a practical diagnostic and therapeutic approach.

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Patients commonly present to their primary care physician chiefly for shoulder pain. Most shoulder problems are due to overuse (tendinitis, bursitis) and trauma, and frequently there is an element of both these basic causes.

Acute shoulder injuries are not difficult to diagnose but require a basic understanding of shoulder anatomy and mechanics. A proper diagnosis is important to prevent long-term and permanent shoulder disability. Most shoulder conditions can be treated nonsurgically and thus are within the scope of practice for primary care physicians. In this article we discuss common overuse and traumatic injuries to the shoulder in adults, with emphasis on a practical diagnostic and therapeutic approach.*

Anatomic Considerations

The shoulder girdle comprises four bony articulations, the glenohumeral joint, the acromioclavicular joint, the sternoclavicular joint, and the scapulothoracic articulation. These osseous structures combine with the soft tissues of the rotator cuff muscles, scapular muscles, fibrous capsule, glenohumeral ligaments, and glenoid labrum to provide a stable but flexible unit that allows the widest range of movement of any joint in the body (Figures 1 and 2).[1]

The rotator cuff is derived from a specialized muscle group arising from the scapula and comprises the supraspinatus, infraspinatus, teres minor, and subscapularis tendons. These tendons insert around the head of the humerus, with the supraspinatus, infraspinatus, and teres minor tendons attaching to the greater tuberosity and the subscapularis tendon to the lesser tuberosity. In general, they act as humeral head stabilizers. The supraspinatus and the infraspinatus muscles are responsible for abduction and external rotation, respectively. The teres minor and the subscapularis are responsible for external and internal rotation, respectively. Tears of the rotator cuff muscles are often responsible for chronic disability of the shoulder and frequently go undetected in the evaluation of shoulder disorders.

The glenohumeral articulation is a ball-and-socket joint. The humeral head has a rather large articular surface compared with that of the glenoid. It is surrounded by a redundant capsule, allowing a wide range of motion. Mobility is obtained at the expense of stability, predisposing the joint to dislocation. The glenoid articulation is deepened by a rim of cartilage, the glenoid labrum, which is sometimes injured in shoulder dislocations or subluxations. The upper portion of the glenoid labrum is continuous with the tendon of the long head of the biceps muscle. Biceps tendinitis or injury to the long head of the biceps tendon is common in overuse and traumatic injuries of the shoulder.

The acromioclavicular joint is a plane joint whose structural integrity is derived from the acromioclavicular ligaments and intrinsic capsule. This joint has minimal mobility. Because of its prominence in the shoulder, it is often the site of injury and subject to degenerative changes (osteolysis, osteoarthrosis) with repetitive trauma. The clavicle is further stabilized by the coracoclavicular ligaments and can be damaged with severe acromioclavicular trauma. Coracoacromial ligaments form a superior shelf of the glenohumeral joint. This shelf, also known as the coracoacromial arch, has importance in the shoulder impingement syndrome.

The sternoclavicular joint is a relatively mobile saddle joint that is rarely the site of injury or disease. When

*See also the editorial by F. Cuomo, MD, "The Value of the History and Physical for Shoulder Pain," on pages 389-390 of this issue.

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ABBREVIATIONS USED IN TEXT

AP = anteroposterior
CT = computed tomography
MRI = magnetic resonance imaging
NSAIDs = nonsteroidal anti-inflammatory drugs
ROM = range of motion

injured, however, associated trauma to the surrounding vital structures—trachea, esophagus, and large blood vessels—should be considered.

Last, the scapulothoracic articulation is the sole link between the upper extremity and axial skeleton and functions as a platform from which the upper limb operates. It is susceptible to both direct trauma with associated injury to the chest wall and underlying vital structures and indirect injury by traction through the musculotendinous structures.

Bursal structures around the shoulder allow smooth gliding motions to take place between muscle groups and bony structures. Often the large subdeltoid and subacromial bursae are involved, with clinical symptoms caused by overuse or injury. With recurrent inflammation, thickening of the bursal walls, with or without calcific deposits, may develop.

Types of Injuries

Overuse

Overuse injuries of the shoulder include bursitis, tendinitis (rotator cuff, biceps tendon, or both), and degenerative or post-traumatic arthritis.[2] The elements of overuse that are frequently implicated are repetitive overhead activities (swimming, throwing, installing drywalls) or unaccustomed repetitive strenuous activity (gardening, golfing, shoveling snow). The impingement syndrome—impingement of the periarticular soft tissues between the greater tuberosity of the humerus and the coracoacromial arch—also plays a common role in overuse injuries.

The cause of impingement can be multifunctional. Glenohumeral instability can be atraumatic, as is commonly seen in swimming and throwing athletes, or can be post-traumatic, as often seen after a shoulder dislocation. Glenohumeral instability leads to increased translation of the humeral head in the anterosuperior direction, narrowing the subacromial space. The resulting impingement on the rotator cuff tendons causes inflammation and weakness. Also, imbalance between the rotator cuff muscles and the scapular stabilizing muscles (rhomboids, trapezius, levator scapulae) can result in excessive protraction and rotation of the scapula, resulting in inferior movement of the acromion and impingement.

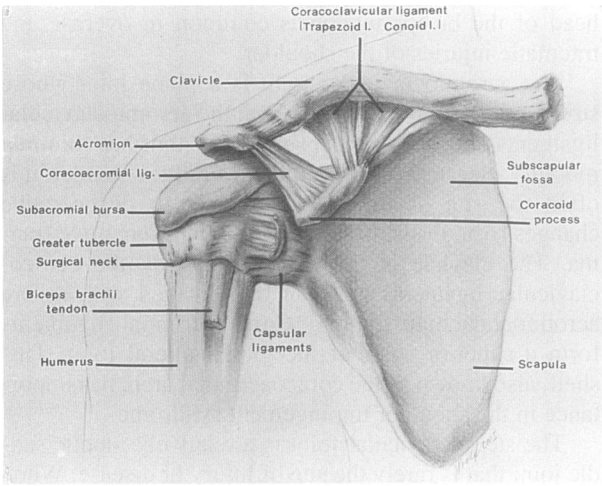
Often the inflammatory condition that causes a patient's pain is the result of impingement or instability (or both), combined with an acute overuse condition. Treatment of the acute inflammatory condition with attention to the underlying primary condition is important to full rehabilitation.

Trauma

Traumatic injuries of the shoulder can be classified as contusions, fractures, dislocations, subluxation, separation, or traumatic impingement.[3] Fractures typically involve the proximal humerus, clavicle, or both. Shoulder dislocations are usually anterior (90%) and, less commonly, posterior (10%). Unfortunately, there is an unacceptable incidence of missed diagnosis with posterior shoulder dislocations. Furthermore, shoulder subluxation is also an overlooked cause of symptoms in patients with pain or functional instability. Acromioclavicular separation is one of the most common injuries of the shoulder and of varying severity. Last, traumatic impingement often results in partial or complete rotator cuff tear, especially in persons older than 40 years.

Evaluating an Injured Shoulder

The proper evaluation of any shoulder injury begins with a thorough history and physical examination. With



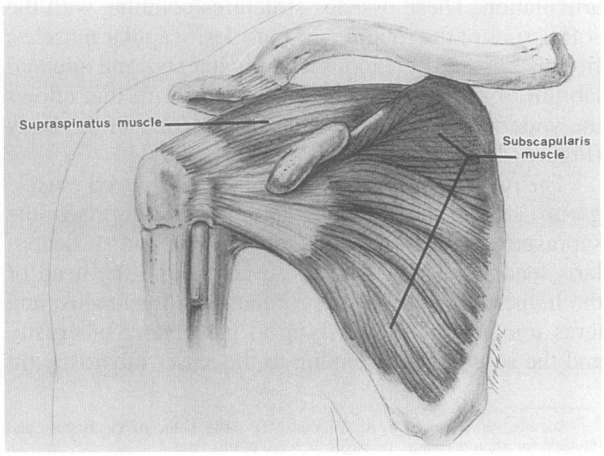


Figure 1.—Left and Right, Anterior views are shown of normal right shoulder anatomy. The major osseous and soft tissue structures are illustrated. The coordination of these structures results in a large functional range of motion.

injuries of the shoulder, the presenting symptom is most often pain with or without associated weakness. A patient with a previously undiagnosed shoulder injury may occasionally present with only a complaint of weakness. A careful history leads to a correct diagnosis in most cases. With both overuse and traumatic injuries, eliciting the precipitating event is most important. The mechanism of trauma, the direction of the force and shoulder position at the time of injury, and the patient's age, occupation, side of dominance, and history of previous shoulder disorders should be considered. With overuse injuries, pain with overhead or throwing activities may indicate impingement, instability, or both. Pain worse after rather than during use of the affected shoulder or pain at night implies an inflammatory condition. In patients in whom shoulder pain is not preceded by a history of overuse or trauma, a serious underlying cause, such as systemic arthritis, infection, neoplasm, or cardiac disease, needs to be excluded. Because of the coexistence of cervical disease, particularly in patients older than 55 years, all shoulder examinations should begin with a quick examination of neck motion.

Adequate exposure of both shoulders is mandatory so as not to miss any subtle asymmetry. Particular attention should be paid to the presence of obvious deformity due to fractures or dislocation, swelling, erythema, ecchymosis, or muscle wasting. Active range of motion (ROM) maneuvers are then performed and compared with those in the asymptomatic shoulder (Table 1). Because movements of the shoulder involve rotating the scapula, active ROM maneuvers should be viewed from behind as well. With overuse injuries, a painful arc of motion, usually between 60 and 120 degrees of abduction, is indicative of the impingement syndrome. A limitation of active ROM may be due to pain, weakness, or both. An inability to abduct the arm implies a complete rotator cuff tear. Partial rotator cuff tears are often accompanied by pain or demonstrable weakness on strength testing, with or without a limitation of active ROM. When active ROM is restricted, passive ROM may help to delineate the cause. With overuse injuries, passive ROM should not be restricted. Restriction of both active and passive ROMs suggests a frozen shoulder or adhesive capsulitis. In this instance, a limitation of external rotation is the most dramatic finding.

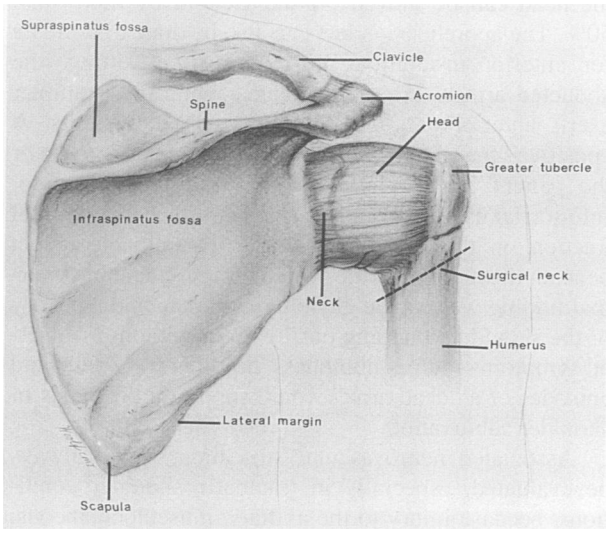
TABLE 1.—*Range of Normal Shoulder Motion*

Motion	*Range, degrees*
Flexion	180
Abduction	180
Adduction	75
Extension	50
External rotation*	65
Internal rotation*	80
External rotation†	90
Internal rotation†	70

*Arm at side.
†Arm abducted 90 degrees.

With traumatic causes, both active and passive ROMs may be restricted due to pain, especially when there is an associated fracture or dislocation. It is important, especially in suspected proximal humeral fractures or dislocations, to limit ROM testing so as to minimize the risk of injury to associated neurovascular structures. The diagnosis is dependent on a radiographic evaluation. Fractures or dislocations of the proximal humerus are difficult to diagnose, and it has been estimated that as many as 80% of posterior locked dislocations are missed by an initial treating physician.[1]

On completing passive ROM testing, strength testing of specific muscles (deltoid, rotator cuff) can be done to distinguish pain inhibition from lack of effort or actual weakness. Subtle weakness may be unmasked or magnified by repetitive contractions that use the effect of fatigue. Remember, weakness can result from muscle or nerve disease. Specific tests such as Jobe's and Speed's tests are useful for assessing supraspinatus and biceps



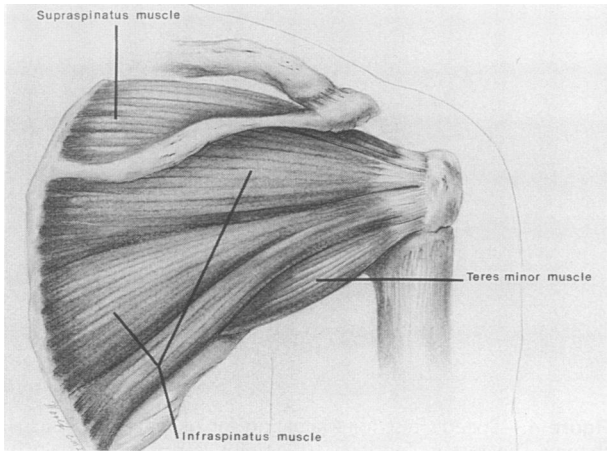


Figure 2.—Left and Right, Posterior views are shown of normal right shoulder anatomy.

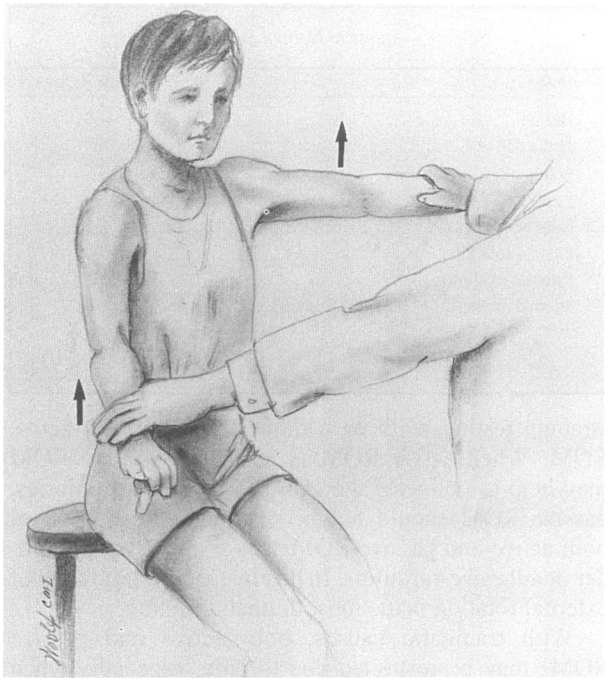


Figure 3.—Jobe's test for assessing supraspinatus integrity is illustrated: A positive test is pain and weakness on manual resistance with arms abducted to 90 degrees, brought forward into 30 degrees of flexion with the arm internally rotated.

tendon integrity, respectively (Figures 3 and 4). Hawkins' test for impingement is also useful (Figure 5).

Palpation is next done to locate the site of pain and disorder. With overuse injuries, pain is often generalized compared with the more localized pain of acute traumatic injury. The biceps tendon is readily palpable in its groove over the head of the humerus just medial to the greater tuberosity. Tenderness on palpation with pain on Speed's test is consistent with bicipital tendinitis. Tenderness to palpation over the acromioclavicular joint

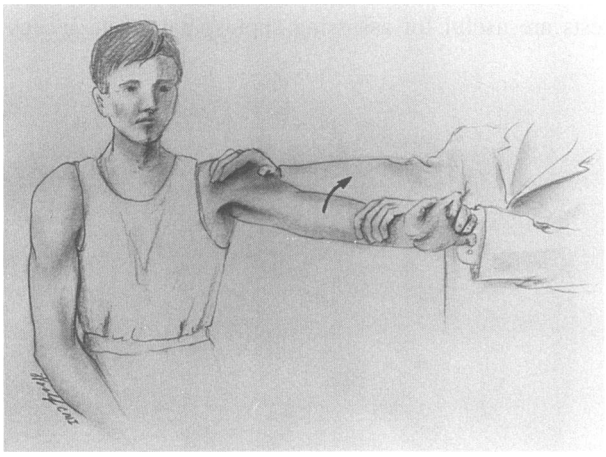


Figure 4.—Speed's test for evaluating for bicipital tendinitis is shown: The test is "positive" (tendinitis is present) if pain is elicited with resisted flexion, adduction, and supination with the elbow extended.

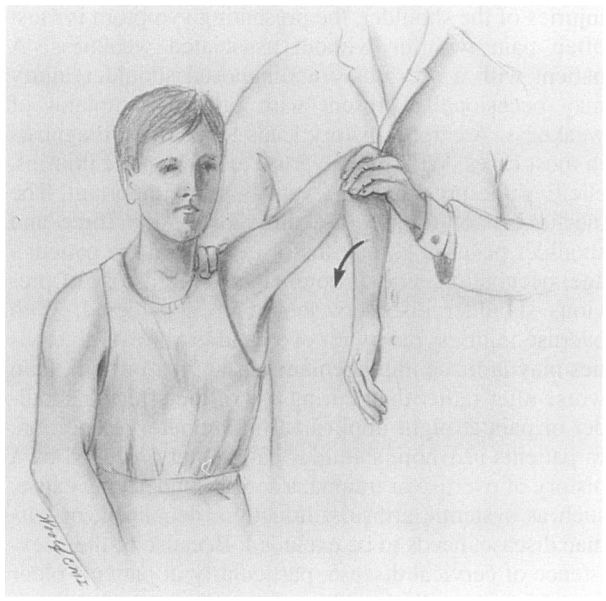


Figure 5.—The diagram illustrates Hawkins' maneuver for assessing for impingement. Pain generated by forward flexion and internal rotation is a "positive" sign (impingement is present).

that worsens with adduction (cross-flexion with the arm at 90 degrees) suggests acromioclavicular arthralgia due to post-traumatic arthritis or to direct trauma with separation. Traumatic injury to the shoulder with associated fracture often has tenderness localized to the fracture site itself. With shoulder dislocation, often the humeral head can be palpated anteriorly or posteriorly relative to the glenoid, with obvious visual deformity on inspection.

Glenohumeral instability can be unmasked by several maneuvers. By palpating the humeral head through the deltoid and stabilizing the scapula with the other hand, attempts are made to glide the humeral head both anteriorly and posteriorly. An abnormal finding is when the head can be moved off the glenoid by more than 50%. The apprehension test can also be done to evaluate for anterior instability. With the patient sitting, the abducted arm is externally rotated while the examiner exerts anterior pressure on the proximal humerus. A "positive" finding is when the patient's muscles tense or the patient has a feeling of impending subluxation. Inferior laxity may be evident when direct longitudinal traction on the humerus results in a palpable defect beneath the acromion, the "sulcus" sign. Such an abnormal finding with vague glenohumeral pain and a history of the shoulder "popping out," with or without associated symptoms such as numbness, tingling, weakness, and episodes of a "dead arm," would support a diagnosis of shoulder subluxation.

Associated neurovascular structures should always be evaluated, especially in traumatic shoulder conditions, because injury to the axillary, musculocutaneous, and ulnar nerves as well as injury to the brachial or radial artery (or both) may be present.

TABLE 2.—*Radiographic Abnormalities of Shoulder Injuries*

Abnormality	*Description*
Traumatic	
Dislocation	Anterior Humeral head inferomedial to glenoid Hill-Sachs deformity
	Posterior Humeral head posterior to glenoid
Proximal humeral fracture	Nondisplaced Usually surgical neck
	Displaced >1 cm or >45 degrees of angulation
Acromioclavicular (AC) separation	1st degree No radiographic abnormality
	2nd degree <1 cm of displacement
	3rd degree >1 cm of displacement
Clavicle fracture	Middle third Most common
	Distal third Assess stability of AC joint
Impingement	A curved or hooked acromion—may be no radiographic findings
Chronic rotator cuff tear	Superior displacement of the humeral head
	Degenerative change in the undersurface of the acromion, humeral head, or both
Overuse	
Bursitis	Calcific deposits, subacromial space
Tendinitis	Calcific deposits, most commonly supraspinatus
AC joint degenerative arthritis	Osteoporosis, widening of AC joint, osteophytes
Osteolysis of the distal clavicle	Cyst formation, resorption, or both
Impingement	Ossification of AC ligament
	Subacromial spur(s)
	Curved or hooked acromion

Diagnostic Tests

Plain radiographs are the first imaging step in the diagnosis of shoulder injuries (Table 2).[4] Standard x-ray films should include anteroposterior (AP) and lateral projections in the scapular plane and an axillary view, motion and pain permitting. The lateral x-ray film in the scapular plane is also known as the Y view (transscapular). The axillary view allows for evaluation of the glenoid articular surface. Both are important in clearly diagnosing fractures and dislocations. A Hill-Sachs lesion—a compression fracture of the posterolateral aspect of the humeral head—will accompany 25% of first-time anterior dislocations and 75% of chronic dislocations.[1] Additional AP views in internal or external rotation will demonstrate the lesser and greater tuberosities of the humeral head, respectively, and are particularly useful in proximal humeral fractures. Specific views of the acromioclavicular joint (AP views with cephalad angulation) for suspected trauma should be done. These often include the opposite normal side for comparison with 10-lb weights (stress views). In cases of obvious acromioclavicular deformity, stress views are not necessary. To assess for clavicular trauma, an AP cephalad view is obtained. The most common site of a clavicular fracture is the middle third. Distal clavicle fractures are less common but more worrisome because of the possible disruption of the acromioclavicular joint.

To assess for overuse injuries, in addition to standard AP and axillary views, a true AP view (40 degrees postero-oblique projection) will show the glenoid in profile. The modified transscapular or outlet view will demonstrate the configuration on the acromion. Acromial structure is an important finding in patients with suspected impingement, as a curved or hooked acromion may contribute to this syndrome. Calcium deposits would suggest calcific tendinitis or bursitis, and this will frequently be missed unless a bright light is used to transilluminate the film. Degenerative changes about the glenoid, consisting of osteophytic lipping, sclerosis, or both, suggest instability or previous subluxation or dislocation. Radiographic evidence of the shoulder impingement syndrome should also be noted (see Table 2). Acromioclavicular joint disease may include degenerative arthritis. Osteolysis or cyst formation of the distal clavicle may be evident in someone with a history of acute injury or repeated stress on the shoulder. Although there is no consistent radiographic finding in acute or partial rotator cuff tears, indirect evidence of chronic rotator cuff tears can be seen radiographically, usually as a narrowing of the space between the acromion and the humeral head and sclerosis of the greater tuberosity.

Additional diagnostic studies such as computed tomography (CT), CT arthrography, magnetic resonance imaging (MRI), or fluoroscopy may be indicated in certain conditions.[4] Magnetic resonance imaging with contrast is becoming the diagnostic test of choice for illustrating soft tissue structures such as labral or rotator cuffs. Computed tomographic scanning is useful in trauma or for further delineating bony disease. Computed tomographic arthrography is useful when MRI scanning is not available. Fluoroscopy, once used to diagnose impingement, is being replaced by MRI where available.

Administering Diagnostic and Therapeutic Drugs

In patients with certain shoulder injuries, drugs may be administered for both diagnostic and therapeutic purposes. When pain precludes an adequate examination and motion is limited, particularly in overuse injuries, when the exact location of the shoulder pain is not clear, or when trying to differentiate apparent weakness from limited motion due to pain, the administration of a drug is a useful adjunct.[5] A selective use of a local anesthetic into the acromioclavicular, glenohumeral joint, subacromial bursa, or long head of the biceps may pinpoint the origin of the pain. A solution of 7 ml of 1% xylocaine is

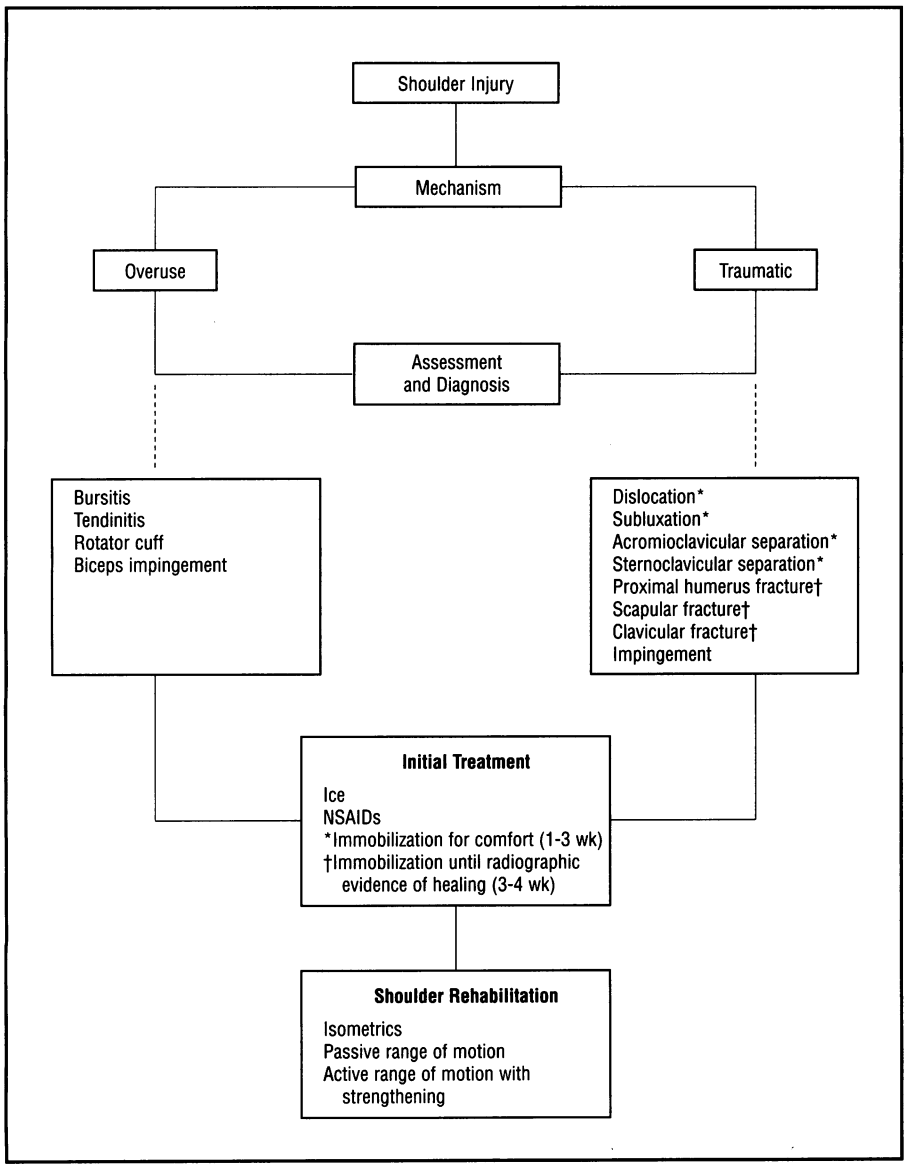


Figure 6.—The algorithm shows the general management of shoulder injuries. NSAIDs = non-steroidal anti-inflammatory drugs

administered under strict aseptic conditions. Specifically, administering the drug into the subacromial space will allow the physician to distinguish pain-inhibited motion due to an impingement syndrome, or bursitis, from weakness due to rotator cuff lesions (tendinitis, tears). Patients who have lessening of their pain or improvement in active motion after receiving a drug may benefit from the administration of a corticosteroid. This procedure should be done only by physicians experienced in such techniques.

Treating Injuries of the Shoulder

The following general treatment guidelines are for both overuse and traumatic shoulder injuries:

- Decrease the inflammatory response with ice, non-steroidal anti-inflammatory drugs (NSAIDs), or both;
- Alleviate pain;
- Properly immobilize the shoulder or use modified rest; and
- Properly rehabilitate to maximize the functional outcome (Figure 6).

In general, shoulder rehabilitation begins with isometric exercises, progressing to passive then active range of motion, incorporating strengthening of the rotator cuff and scapular stabilizing muscles (Figure 7). The specifics of treatment depend on the diagnosis.

Acromioclavicular Joint Injuries

Acromioclavicular joint injuries can be classified into first, second, and third degree, depending on the degree of separation.[6] A first-degree injury is noted by

swelling, pain, and ecchymosis, without obvious joint deformity, signifying minimal ligamentous disruption and instability. Treatment includes ice, pain medications, a sling for comfort, and early mobilization. A second-degree injury implies more tearing of the joint capsule with subluxation noted on stress x-ray films. Treatment is symptomatic but usually requires a longer period of immobilization (2 to 4 weeks) with a sling. If a patient is involved in contact sports or heavy labor, he or she should not resume full activities until full ROM and strength have been restored. In a third-degree injury, there is complete tearing of the acromioclavicular joint and the coracoclavicular ligaments. There is an obvious "step-off" on physical examination with an accompanying deformity on x-ray films. Third-degree injuries are further classified into grades 3 to 6, depending on the amount of coracoclavicular separation, associated damage to the surrounding deltotrapezius muscles, and the position of the displaced lateral end of the clavicle.[1] Grade 3 is characterized by an upward displacement of the clavicle and an increase in the coracoclavicular space by 25% to 100%. Grade 4 is characterized by an increased coracoclavicular space of 100% to 300%. Grade 5 involves associated posterior clavicular displacement with tearing of the deltoid and trapezius muscles. Grade 6 is a rare type in which there is not only complete disruption of the ligaments, but the distal clavicle is dislocated inferiorly.[1]

Conservative treatment with a sling for a grade 3 injury is appropriate, provided the patient understands that a permanent deformity may result.[7] Patients usually return to normal function. Surgical treatment is possible if symptomatic treatment fails. Treatment is controversial for athletes or those involved in heavy labor. For patients who want a cosmetically "normal joint," surgical therapy is recommended. Grades 4 to 6 injuries require orthopedic referral.

Clavicular fractures frequently involve the middle third (80%). These are generally treated with a figure-of-8 bandage or a sling.[3] Usually shortening or deformity results, but this is painless and does not affect function. The period of immobilization varies between four and six weeks. Referral is needed for open fractures or fractures associated with neurovascular injury. Distal third fractures are classified into types 1 to 3 according to the degree of coracoclavicular ligament and acromioclavicular joint injury. These should also be referred to an orthopedist.

Proximal Humerus Fractures

The majority (80%) of proximal humeral fractures can be treated by immobilizing with a sling and early range of motion based on fracture stability.[3] The period of immobilization varies from one to three weeks, depending on a patient's symptoms. Rehabilitation starts with pendulum exercises for passive ROM followed by isometrics and then active ROM. These fractures are further classified according to the presence or absence of displacement of the humeral head, the lesser and greater tuberosity, and the humeral shaft.[8] If any of these segments are displaced more than 1 cm, if there is more than 45 degrees of angulation, or if there is any question about the alignment or displacement, then consultation with an orthopedist is warranted.

Shoulder Dislocation and Subluxation

Shoulder dislocation often represents a higher-energy injury. Various methods of longitudinal traction with adequate anesthesia are used to reduce dislocations. These injuries are difficult to deal with in an office setting, and referral may be appropriate. Sling-and-swathe immobilization follows reduction to allow adequate capsular healing. Rehabilitation starts with isometric exercises, followed by passive and active ROM exercises within two weeks, avoiding the extremes of abduction and external rotation. The younger the patient, the greater the chances of redislocation. Associated rotator cuff tears in an older patient and labral injuries in a younger may result in persistent instability and may complicate the progress of a patient's rehabilitation. A failure to progress necessitates referral.

Traumatic shoulder subluxation is treated symptomatically, depending on the severity of the symptoms. Treatment can range from modified rest and restriction of motion to a sling with as long as two weeks of immobilization. We use a subluxation prevention program that emphasizes strengthening in a pain-free and restricted range while allowing the capsule to heal. Occasionally an associated labral injury will lead to functional shoulder instability.

Scapular Fractures

The treatment of most scapular fractures is immobilization by a sling for two to three weeks, followed by early ROM exercises. Scapular fractures that involve the glenoid, neck, acromion, or coracoid often require orthopedic consultation.[9]

Sternoclavicular Injuries

Injuries to the sternoclavicular joint are categorized into first-, second-, and third-degree injuries, depending on the degree of associated capsular disruption.[1] First- and second-degree injuries are treated symptomatically. Third-degree injuries with dislocation are fortunately rare. This is a serious injury if there is posterior displacement because of possible tracheal and large-vessel compromise. Immediate reduction is required in these cases.

Traumatic Impingement

A fall onto an outstretched hand or onto the proximal humerus can cause traumatic impingement. Initial treatment consists of ice, NSAIDs, and modified rest with or without a sling, depending on the severity of a patient's symptoms. As the patient's symptoms resolve, and if further strength testing of the shoulder shows a rotator cuff tear, an adequate period of rehabilitation (2 to 3

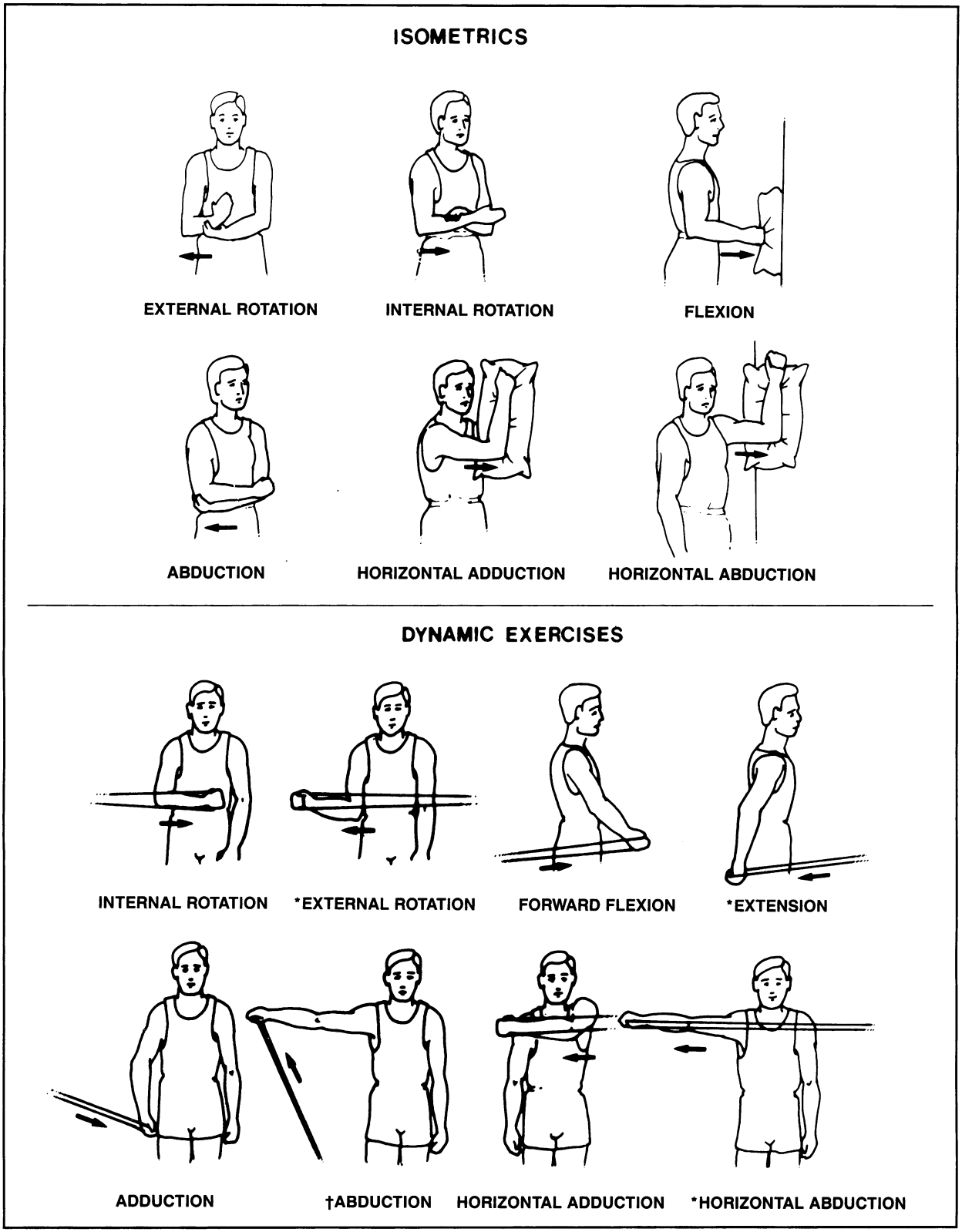


Figure 7.—Shoulder rehabilitation exercises are shown: Isometric **(top)** and dynamic **(bottom)** strengthening exercises are started once the acute inflammatory phase has resolved. All exercises should be done free of pain. For isometrics, hold a submaximal contraction for 5 seconds and repeat 10 times. Surgical tubing of various strengths is used for dynamic strengthening, generally incorporating 3 sets of 15 to 20 repetitions. * = subluxation prevention program: to neutral position (0 degrees) only, † = impingement protection program: to 45 degrees only

months) will often lead to good functional results.[10] Referral to an orthopedist is appropriate for possible surgical intervention if the patient fails to improve or the patient is an athlete or heavy laborer. Early recognition of this injury improves the subsequent outcome.

Overuse Injuries

Rotator cuff tendinitis, subacromial bursitis, bicipital tendinitis, and degenerative or post-traumatic arthritis should be treated initially with ice, NSAIDs, and modified rest until pain-free, followed by active ROM exercises and strengthening. If the impingement syndrome is present, the underlying biomechanical abnormality—glenohumeral instability, muscle imbalance, or poor throwing or swimming techniques—should be addressed. Also, specific rehabilitation should be directed toward rotator cuff strengthening and impingement protection, avoiding ranges that stress the shoulder. If these conditions fail to respond, administering a corticosteroid to the joint and physical therapy are often effective. Physical therapy modalities of ice, ultrasound, laser, and interferential therapy are useful adjuncts. In refractory cases, referral to an orthopedist is appropriate.

In summary, in treating common shoulder injuries, proper diagnosis and an aggressive rehabilitative approach are key to obtaining a good functional result and in preventing long-term disability.

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